We are rather surprised that no mention of the bustard should be made in the tract. Though now extinct in England, the bird was by no means uncommon in the open country at the commencement of the present century. We can only suggest that the cause of its omission from the Herald's list and its gradual extinction in England, is one and the same. Being slow to take wing, the bird is of little or no use for sporting purposes, and nature has implanted in it a rooted aversion to those enclosures which, in a land like ours, alone are sacred to game.

CHARLES J. ROBINSON

POPULAR LECTURES ON PHYSIOLOGY

Populäre Physiologische Vorträge gehalten in Akademischen Rosensaale zu Jena, 1867-1868-1869. Von Prof. Dr. Joh. Czermak. (Wien, 1869. London: D. Nutt.)

THE daily increasing recognition of the importance of Physiology as an element of liberal culture, no less than as a distinct branch of science, may be said to be intimately connected with the gradual displacement of the old vitalist conception. The old conception of Life as something essentially mysterious and removed from out the circle of natural causes, has been set aside in favour of the conception of Life as something more complex, indeed, but not otherwise more mysterious than other natural phenomena, and dependent upon the physical and chemical agencies recognised in operation in other provinces of research. The consequence of this changed view has been to disclose the need of an incessant application to Physiology of those instruments and methods which have enlarged and given precision to our views of Nature; and a further consequence has been that the problems are found to be more capable of popular exposition, that is to say, the great results of research can now be *shown* to an intelligent public, and made thus to form an element in general culture.

It is under this second aspect that Prof. Czermak's Lectures call for remark. Himself an original investigator and inventor, he here gives excellent examples of the kind of teaching that may become generally effective—namely, an intelligible exposition, for the laity, of the painfully-acquired results of science. This exposition is not confined to an oral statement of results, which statement might be imperfectly apprehended and quickly forgotten, but is accompanied by a visible demonstration which fixes it in the memory as with a burin. In his first lecture he expounds the action of the heart, and the influence of the nervous system on the circulation. In this he exhibits the instrument formerly invented by him, the Cardioscope, which enables an immense audience to *see* the rhythmic beating of the heart when taken from the body; and by the directions and the plates here supplied teachers and private students may easily furnish themselves with the ingenious contrivance. Indeed, we may say at once that this volume will be especially useful to teachers who will gain from it several effective aids for their lectures.

The second lecture is on the Ear and Hearing, and gives a lucid account of all but the very latest discoveries (the startling and *disturbing* discovery which robs the Corti apparatus of its former significance being subsequent to the publication of this volume). The third and fourth lectures are on the Voice and Speech, accompanied like the others with excellent and instructive diagrams, and a very intelligible explanation of the instrument with which Prof. Czermak's name has been carried all over Europe and America—the Laryngoscope.

A mere glance at this volume, and the elaborate application of mechanical aids which it suggests, will indicate at once the great change which has come over physiological investigation in the last twenty years. Not to speak of such works as those of Richerand and Majendie in France, or of Elliotson and Mayo in England, where there is scarcely a trace of the physical and chemical investigation now considered indispensable, let even the great work of Müller be opened at the places where the heart, the ear, and the voice are treated, and compared with these lectures, addressed, be it observed, to a miscellaneous audience of ladies and gentlemen, not to students in a class-room, and the contrast will, as the French say, leap at the eyes. The changed direction is one that attempts to reduce physiological problems to visible and measurable processes, which leave no room for vagueness or inexactness, and which, without getting rid of the mystery of Life, reduces the phenomena of Life to what Prof. Huxley finely names the "realm of *orderly* mystery."

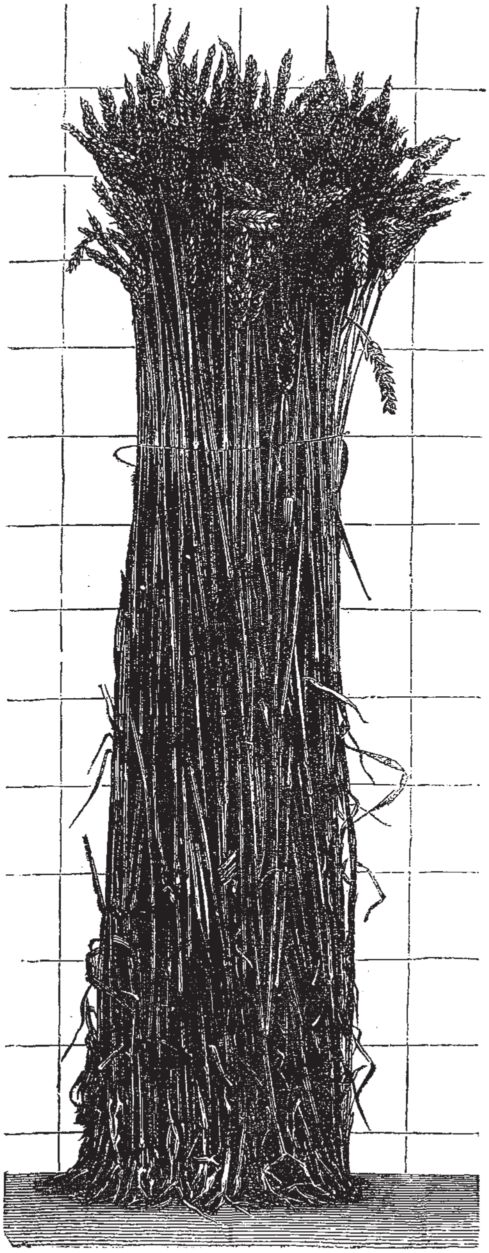
GEORGE HENRY LEWES

AGRICULTURAL CHEMISTRY IN FRANCE

L'Ecole des Engrais Chimiques; premières notions de l'emploi des agents de fertilité. By M. Georges Ville. 12mo., pp. 108, with one plate; price one franc. (Paris: Libraire Agricole de la Maison Rustique, 1869.)

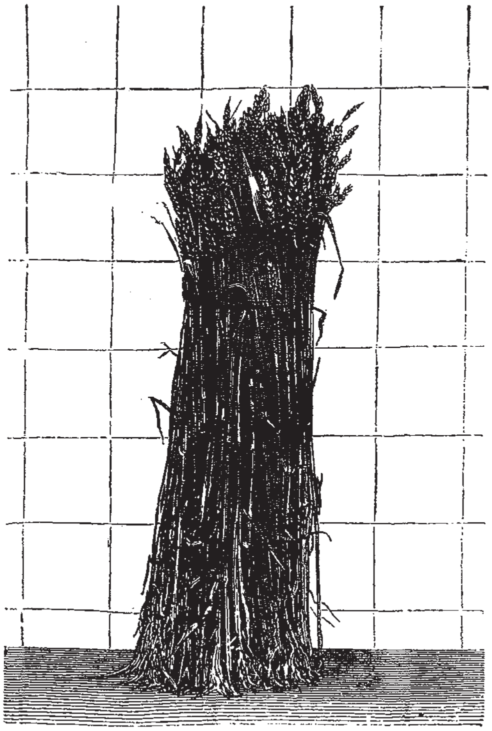
INTELLIGENT visitors to the last annual meeting of the Royal Agricultural Society, held at Manchester, could hardly fail to draw one very important conclusion from the sight of that vast array of implements, machines, and produce, namely, that year by year farming is brought more and more under the application of scientific principles. It is found, too, that farm labourers, not quite so stupid as was thought, are capable of managing agricultural machines, and of adapting themselves to the improved style of work which these necessitate. And among our farmers the number of those increases who know that, however much plants may differ in appearance and properties, they have a character in common, and owe their formation to certain elements which suffice for their requirements, as the letters of the alphabet suffice for the requirements of writing and printing. And their sons at school will learn that of these plant-forming elements, the more important are, carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, chlorine, silicon, calcium, magnesium, potassium, sodium, and iron. Schools and colleges have taken the subject in hand, and have demonstrated that the study of the sciences on which agriculture may be said to depend, involves no small amount of intellectual culture —a culture fraught with lasting interest.

On the Continent, also, a movement has begun for the improvement of agriculture, and it will be instructive to look at what has been accomplished in France. Among the subjects on which lectures are given by the able professors at the Museum of the Jardin des Plantes is *la chimie agricole*—agricultural chemistry—and, in the hands of Prof. G. Ville, who has been experimenting thereon for the past twenty years, it has produced surprising results. Having established his propositions single-handed, and at his own cost, a portion of the imperial domain at Vincennes was allotted to him, as an experimental farm, and the crops he there produced, the *Conférences Agricoles* he there held among the crops, together with his numerous published works, and the effect of his lectures, have made such an impression, that his method of cultivation has been adopted at more than five hundred places in France; while from Spain, Portugal, Italy, Belgium, and Germany, and from the French colonies, farmers and cultivators have resorted to Paris and to the experimental farm at Vincennes, to acquaint themselves with the method which under ordinary circumstances would more than double their harvest.



Comparative size of wheatsheaf produced from soil completely manured.

Prof. Ville's method of instruction is as simple and definite as his method of fertilisation, as if he had in view the large number of small peasant proprietors in France, and wrote and lectured for their especial benefit. You may sow wheat, he says, in soil wanting nitrogenised matter, phosphates, potash, and lime, and it will grow and bear grain, but the stalk will be very short, thin, and weak, and the vegetation precarious. Mix with the soil a substance composed of carbon, hydrogen, and oxygen, the result will be exactly the same. And why? Because plants take all the carbon they need from the carbonic acid of the atmosphere, and hydrogen and oxygen from water. Hence, to add these three elements to the soil is useless; on the other hand, if some substance containing assimilable nitrogen be added, a salutary effect is at once produced, for plants derive nitrogen partly from the soil, partly from the air. But this effect is as nothing compared with that of manures affording certain mineral elements: mix these as well as the nitrogenised matter with calcined earth, and its fertility will equal that of the richest soil. The vegetation, no longer thin and starved, acquires vigour and activity, the plant grows straight and strong, is of a rich green colour, and produces a well-formed ear filled with large and heavy grain.



Comparative size of wheatsheaf produced from soil without manure.

Many of the mineral elements required by the plant already exist in the soil; consequently, to render it productive the farmer has to discover which of the fertilising elements are wanting, and apply them to his field. To do this, it is not necessary that he should be an analytical chemist: the vegetation of his fields will do it for him. He has only to sow or plant a small experimental plot, and the appearance of the crop will tell him what is deficient in the soil. And in making his experiments, he is not restricted to any special kinds of plants, for the method may be applied to the sugar cane, the sorgho, and other natives of the tropics, to maize, beetroot, the Jerusalem artichoke, the potato, colza, and other varieties of cabbage, and to flax and hemp. Whether saccharine, or oleaginous, or fibrous, or starchy, the plants may be developed to the utmost limit of their productiveness by proper treatment.

The complete fertiliser, or *engrais complet*, as Prof. Ville calls it, varies slightly in composition according to the nature of the crop required. For wheat it is composed of acid calcium phosphate (superphosphate of lime), potassium nitrate (nitre), ammonium sulphate, and calcium sulphate (gypsum). These materials require to be skilfully mixed, so as to retain all their beneficial properties when spread upon the land. The "engrais complet" is to be regarded as the typical fertiliser—the standard by which to judge of the value and the lastingness, so to speak, of any chemical manure. A field properly treated with this will return three or four crops of wheat in immediate succession, without further manuring in the meantime.

For the proper carrying on of the experiments, it would be necessary to have—

1. The complete compost.
2. Compost without potassium salts.
3. „ without phosphates.
4. „ without nitrogenised matter.

These are to be applied to the experimental plots of land. If then, number 2, or 3, or 4 produces the same effect as number 1, it is evident that the substances represented by those numbers exist already in the soil, that the vegetation has profited by them, and that there is no need to apply them to the land. If, on the contrary, the compost in which any one of the four substances is wanting produces a deficient crop, there is a certain proof that this particular element of productiveness is deficient in the land.

Here, then, is a method of analysing the soil of fields and gardens which even an intelligent labourer might practise. He could hardly continue the practice without learning, better than from books, the true principles of agricultural science. He could determine step by step the loss of any one or more of the fertilising elements, and consequently ascertain which was required to restore the fecundity of the soil.

In support of this argument, Prof. Ville brings forward some remarkable results obtained on his experimental farm at Vincennes, giving tables showing the cost of cultivation and the yield of each experimental plot. He also places before his readers a series of figures in which the results obtained with wheat are displayed in a most forcible manner. The two examples here given indicate the limits of his experimental system. The sheaves are represented on the same scale, so that the results of good feeding and starvation may be readily compared. The intervening figures may be imagined.

If the experiment be made with peas, there is a marked difference in the result: the nitrogenised matter which tells in the culture of wheat has little or no effect on leguminous plants; the reason being that wheat takes up from the soil most of the nitrogen it requires, and that leguminous plants derive it mainly from the air. To produce a good crop of the latter we must employ a manure containing an excess of potassium salts, and for turnips we require an excess of calcium phosphate.

These are important facts, for they show that besides variation and rotation of crops, there can be also rotation of manures. Take any average field, and apply to it the materials which act on the required crop, and so pass from one to the other until the land shall have received all the materials which make up the complete compost.

This, briefly sketched, and with omission of certain practical details, is Prof. Ville's system for the improvement of agriculture in France. The five million small proprietors, who own each from 3 to 14 hectares, have herein a simple and efficacious method, by which their profits may be largely increased, and their own condition materially ameliorated. To quote the Professor's words, "The tiller of the soil is always in presence of a Power superior to himself. Seasons, temperature, rain, and sunshine, which enter so largely into the success of his labours, are above his influence. He learns that skill, foresight and economy are required of him; he knows also that when he has done all that depends on himself he must be resigned and wait. By temperament, as much as by condition, he becomes above all the friend of order, and, in case of need, its firmest support."

OUR BOOK SHELF

Landwirthschaftliche Zoologie. Von Dr. C. G. Giebel. 8vo. pp. 827, with 510 woodcuts. Glogau, 1869. Carl Fleming. (London: Williams and Norgate.)

ALTHOUGH the study of economic zoology ought to be of some importance in this country, we can point to very few English publications relating to it,—Curtis's "Farm Insects," and the translation of Kollar's "Garden Insects," by Westwood and Loudon, being almost the only special works on the subject that we can call to mind, and these are now of old date. This may perhaps be due to the fact that the advantage of attempts at the practical application of zoological and, especially, of entomological knowledge, is very frequently doubtful, but it is certain that in many cases an acquaintance with the natural history of animals must be most valuable to the farmer or gardener, by enabling him to distinguish beneficial from injurious creatures; it is therefore much to be regretted that we possess no good treatise which would place the necessary knowledge within reach of our English agriculturists.

There is another point of view in which the study of economic zoology is of great importance. From the very nature of their relations to man and the organisms which he has taken under his care, useful and injurious animals acquire a remarkable prominence, and thus the phenomena of their existence are brought near to us and, as it were, magnified in such a manner as to render their investigation comparatively easy. Accordingly, there can hardly be any better means of acquiring a practical general knowledge of natural history and, especially, of the intimate and intricate relations of organised beings, than the study of the enemies and benefactors of the farmer and gardener.

Dr. Giebel seems to have taken this view of the matter, and his "Agricultural Zoology" is really a complete natural history of terrestrial animals, the illustrative examples being drawn from domestic animals, or from species which exert a more or less direct influence upon the results of agricultural operations. Of all these, the natural history is given by Dr. Giebel in considerable